

CLAIMS

1. A laser element driving apparatus comprising:

a laser element that varies light intensity corresponding to a current that flows;

a photo-detection element that monitors and converts to electric signals the light intensity of the laser element;

an emission control switch that controls the current flowing to the laser element;

a feedback amplifier that controls the emission control switch by feeding back electric signals of the photo-detection element; and

an emission control switch controlling circuit that determines as abnormal a current flowing continuously to the laser element for a predetermined time from the beginning of light emission of the laser element, and that turns OFF the emission control switch.

2. A laser element driving apparatus comprising:

a laser element that varies light intensity corresponding to a current that flows;

a photo-detection element that monitors and converts to electric signals the light intensity of the laser element;

an emission control switch that controls the current flowing to the laser element;

a feedback amplifier that controls the emission control switch by feeding back electric signals of the photo-detection element; and

an emission control switch controlling circuit that controls the emission control switch such that the current flowing to the laser element, when the laser element begins to emit light, is gradually increased.

3. The laser element driving apparatus according to Claim 2, wherein the emission control switch controlling circuit determines as abnormal a current flowing continuously to the laser element for a predetermined time from the beginning of light emission of the laser element, and turns OFF the emission control switch.

4. The laser element driving apparatus according to Claims 2 or 3, wherein the emission control switch controlling circuit includes a capacitor and an emission stop switch and wherein when the laser element begins to emit light, the emission control switch is forced to turn OFF and said capacitor is charged by turning the emission stop switch ON, and after a predetermined time has elapsed, the emission control switch is controlled by turning the emission stop switch OFF and discharging said

capacitor, and then the current flowing to the laser element is gradually increased.

5. The laser element driving apparatus according to Claim 4, wherein the emission control switch controlling circuit determines as abnormal a current flowing continuously to the laser element for a predetermined time from the beginning of light emission of the laser element, and turns OFF the emission control switch by turning ON the emission stop switch.

6. The laser element driving apparatus according to Claim 1, wherein the emission control switch controlling circuit includes an emission stop switch, determines as abnormal a current flowing continuously to the laser element for a predetermined time from the beginning of light emission of the laser element, and turns OFF the emission control switch by turning ON the emission stop switch.

7. The laser element driving apparatus according to Claims 5 or 6, comprising an oscillator which outputs a reference clock for counting the predetermined time from the beginning of light emission of the laser element up to the determination of abnormality, wherein oscillation operation of the oscillator is stopped when the abnormality has been determined.

8. The laser element driving apparatus according to any of Claims 4 through 7, further comprising a power source switch which is provided between a power source and an inner power source, and which opens and closes corresponding to intermittent control signals, wherein

the inner power source supplies power to the emission control switch, the feedback amplifier, and the emission stop switch, and the current drive capacity of the emission stop switch is higher than the current drive capacity of the sink current side on the feedback amplifier.

9. The laser element driving apparatus according Claim 8, further comprising a fail-safe circuit which includes a counter that starts from the rise of the inner power source, and counts the number of the reference clock of the oscillator, wherein

when the counter reaches the predetermined count, the fail-safe circuit determine an abnormality and outputs a signal that cause the emission stop switch to turn ON.

10. The laser element driving apparatus according Claim 8, further comprising a soft-start which includes a counter that starts from the change of the intermittent control signal when

the power source switch is conductive, and counts the number of the reference clock of the oscillator, wherein

when the counter reaches the predetermined count, the soft-start circuit outputs a signal that turn OFF the emission stop switch so that said capacitor of the emission control switch controlling circuit discharges.